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PEDAGOGISKA INSTITUTIONEN

Report nr 55

# The PUSS-project nr XX

## *PUSS in Cambridge - Three lectures about the Swedish Blindness Research project held in Cambridge*

*Jan 1975*

Nils Trowald (ed)

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## ABSTRACT

PUSS in Cambridge: Three lectures about the Swedish Blindness Research Project, held in Cambridge, January 1975. Department of Educational Research, School of Education, Uppsala.

The present report consists of a summary of research by the PUSS Project in three major areas of interest: talking books, Braille, and the reading behaviour of the partially sighted. Reading via talking books and the factors which are of importance for active listening were the subjects of the first lecture, which also included descriptions of the differences in listening ability between the sighted and the visually handicapped, as well as the concept of listening strategies, all of which were related to *inter alia* physiological factors.

In the second lecture, research on Braille was described: the starting point was a apparatus developed by the Project; this machine enables a detailed description of the actual reading process as it occurs in Braille reading. During reading, the time and pressure can be registered for each individual letter under natural (i e nonlaboratory) conditions. Furthermore, a description was given of an investigation concerning the effect contractions have upon reading speed; this latter study was carried out in cooperation with the Danish Society of the Blind.

The final lecture discussed the Project's efforts for the partially sighted. Four substudies were described: a) recording the reading process in the partially sighted (as registered by eye, head and paper movements), b) development of a diagnostic reading test, c) evaluation of various reading aids, and d) research concerning typography for the partially sighted.

Index word: Blind
Partially sighted
Talking book
Learning strategies
Braille
Reading aids

## I. INTRODUCTION

The present report constitutes one of a series by the PUSS Project (Pedagogical Investigations concerning the Study Situation of the Visually Handicapped), which is conducted by the Department of Educational Research, School of Education, Uppsala, in cooperation with the Association for the Blind, Stockholm.

The purpose of the Project is to illuminate and improve the study situation of the visually handicapped; in this connexion, primary emphasis is placed upon problems concerning learning psychology and study techniques involved in the use of special media.

The good international contacts established by the Project during its research over the years led to an invitation for project personnel to take part in a research conference in Cambridge during January, 1975. The conference was arranged by The Southern Regional Association for the Blind, London, and bore the working title, "The Louis Braille British Conference on Research into Reading and Listening by the Visually Handicapped". The conference was given the title "The Louis Braille British Conference" in honour of the fact that 150 years ago Braille invented the system that became so useful for the blind.

The present report has two major purposes:

A. At the approaching conclusion of the PUSS Project, to contribute to a summary of the research efforts carried out within the areas of auditive and tactile reading, as well as within the area of visual handicaps;
B. To document the contributions made by PUSS personnel at the Cambridge conference.

The report has been divided such that Nils Trowald is responsible for the overall editing of the report, and for the introductory chapter, as well as for Chapter II (Learning Strategies for Blind Listeners). Margareta Löthman is responsible for Chapter III (Research on Braille Reading) and Hans Smedshammar for Chapter IV (Research on Reading Problems of the Partially Sighted).

## II. LEARNING STRATEGIES FOR BLIND LISTENERS

by Dr Nils Trowald, Director of the Swedish Blindness Research Project "PUSS", School of Education and Uppsala University, Sweden

### 1. Introduction

I am going to talk about blind people's way of listening and how we can make this listening more effective - at least for people who use tape recorders in their study situations. But first I want to analyse the listening situation a little and see how listening and learning capacity differ from person to person and show that blind people - who are more trained in listening - have a better ability to cope with the auditive message than the sighted have. We shall call this "learning strategies", and later on I will try to analyse what I mean by this. Then I shall use some of the results from our research at the PUSS-project in Uppsala in Sweden.

### 2. Listening levels

Most studies show that the more mentally active the listener is the better he will learn. I shall therefore relate the term "listening" to the following three activity levels in listening:

a) Hearing

Hearing implies a low level of mental activity and is merely the ear's recording of sound. Hearing can be compared with the visual term: seeing.

b) Listening

Listening implies a greater degree of mental activity and is the brain's understanding of the recorded sound. Listening can be compared with the visual term: observing.

c) Auding

Auding is the highest level of mental processing of the recorded sound, and also includes listening with analytical ability and critical reasoning. Auding can be compared with the visual term: reading.

The brain is activated to varying degrees at these different listening levels, but in order to most effectively learn a given material, our listening should possess the characteristics of auding, a fact which requires a physiological explanation. First, however, I shall say a few words about another kind of activity: the muscular and motor activity.

## 3. Motor activity

Talking book reading is often an "inactive activity". Compared to visual reading, the talking book reader cannot change from ordinary reading to skim-reading or slow reading, "turn over", make a survey of the book, make marks, exercise spelling, etc.

Certain kind of muscular activity will often help the student to get rid of his drowsiness. Of course, it is better if those activities are related to the learned material in a meaningful way, e.g., construction of questions or manipulation of the tape recorder. In the literature, Rothkopf has given those activities a special name, "Mathemagenic activities", and the most important of those are:
note-taking, recitation and construction of questions; other activities, such as knitting, also seem to have a positive effect on the activity of the brain.

From a physiological point of view, I shall now explain the importance of those motor activities and the importance of giving the listening situation the characteristic of auding.

## 4. Physiological background

Physiological research has shown that all forms of stimulation can increase the general activity of the brain. A special centre in the brain, called the Reticular Formation, is concerned in this process. Researchers have thus shown that all stimulation of the body, which includes both inner stimulation in the form of thought processes and outer stimulation in the form of, e.g., motor activities, causes activation of the reticular formation, which in turn stimulates the cortex.

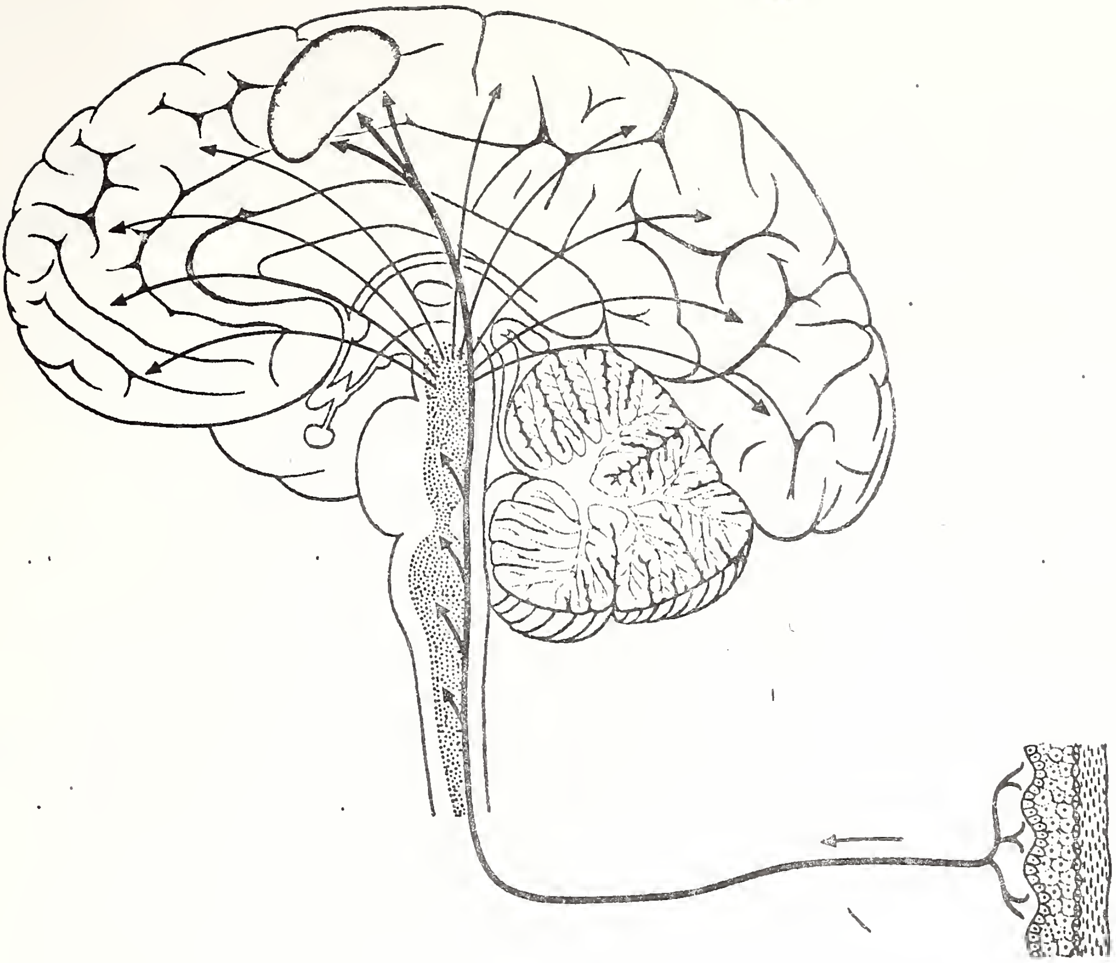

Figure 1. THE RETICULAR FORMATION in the brain. A sense organ (lower right) is connected to a sensory area in the brain (upper left) by a pathway extending up the spinal cord. This pathway branches into the reticular formation. When a stimulus travels along the pathway, the reticular formation may "awaken" the entire brain

A more effective listening situation will thus take place if the students are subjected to both inner and outer stimulation, e.g., taking notes, use of another tape recorder into which he records questions and answers about the text, manipulation of the tape recorder so that he can listen at increased speed, etc.

Later on I shall return to those practical consequences but before that I think it is necessary to explain the relation between learning capacity and activity level.
If the stimulus flow is too high - e.g., too much noise or too high tape recorder speed, you will not be on the optimal level. It is very important to think about this when studying the inner or intrinsic stimulation (or activity): if a student, for example, has an extremely high motivation for a learning task, his learning capacity is not optimal.

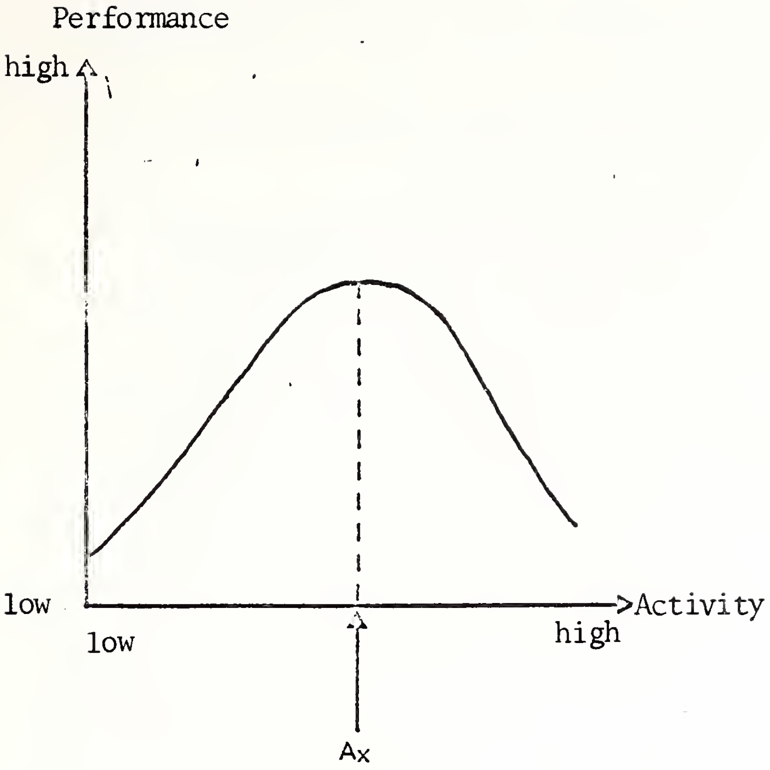

Figure 2. Simplified connection between brain activity (arousal) and performance

Parents may, for example, pressure their son to become a doctor and the students does not want to disappoint his parents. He may then often become so anxious in the examination situation that his capacity will not be optimal.

This can also be illustrated by the behaviour in critical situations:
- if you are too motivated to de your best, the brain will be blocked and your performance will decrease.

I think that his is important to bear in mind for those of us who work with blind children. We must help them to a realistic understanding of their capacity - otherwise they will not work at the optimal level.

After this background sketch, I shall now talk about differences in listening capacity between blind and sighted, a capacity which favours the blind. As the blind are more trained in listening than are the sighted, the blind have acquired certain types of more effective listening methods. This we have called "learning strategies" and I shall now explain what I mean.

## 5. Listening strategies

First I want to compare the listening situation with visual reading, in order to see if there are any differences between these information media.

Our research concerning this relationship has yielded the following results:

a) Auditive short-term memory is superior to visual for sighted persons.

b) When testing is slightly delayed, the differences between auditive and visual memorization are eliminated.

c) When testing is conducted approximately 15 minutes after presentation of the stimulus, visual memorization is superior to auditive. This difference lasts for about one week.

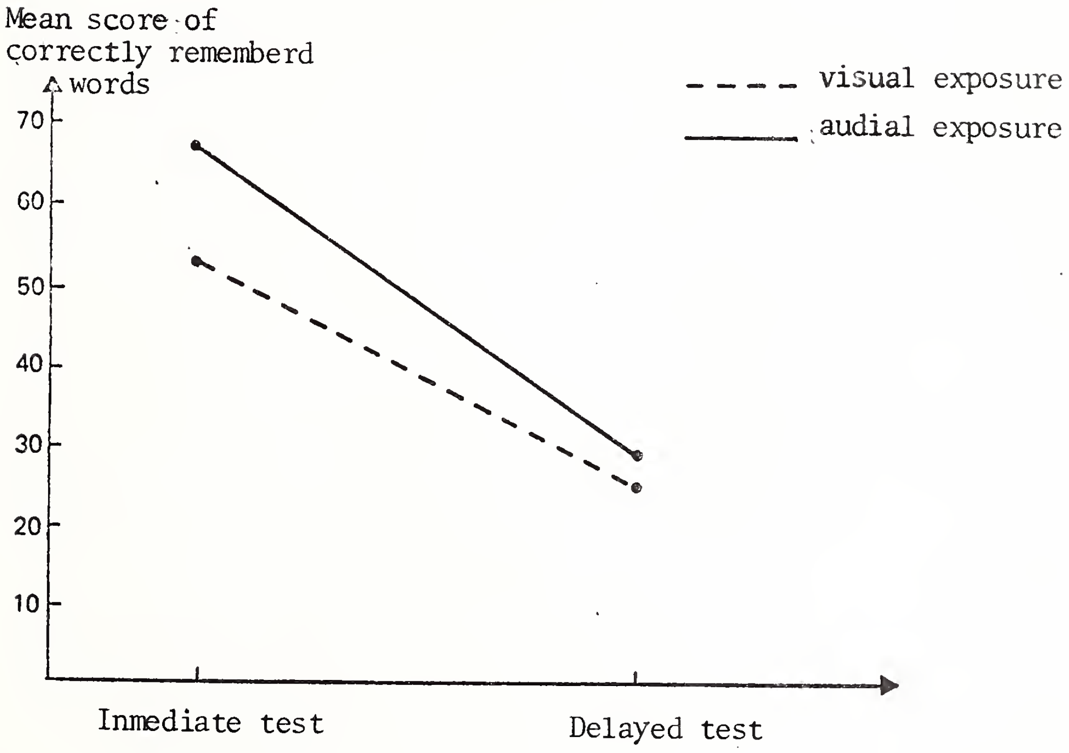

Figure 3. Mean score of correctly remembered words

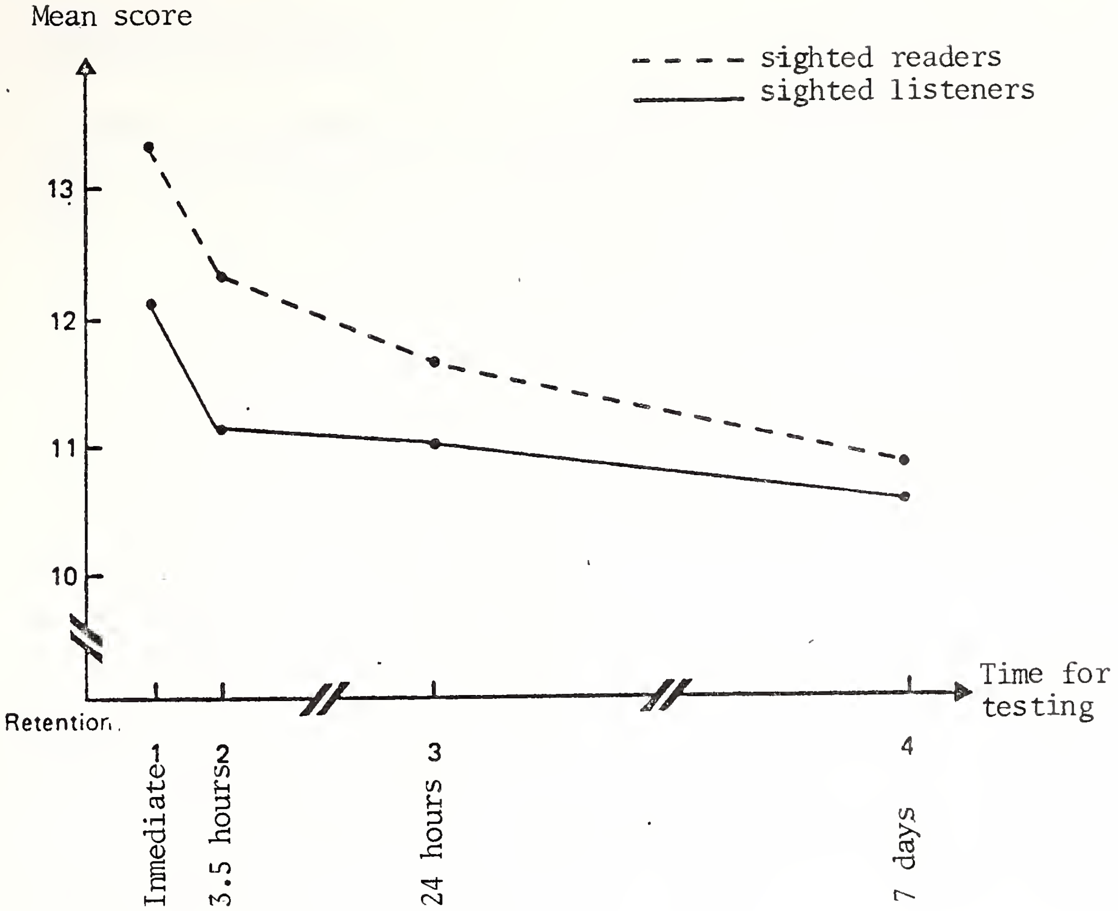

Figure 4. Mean score of retention

These experiments were done with sighted people, and as irrelevant factors were under control, we can say that for sighted people the visual reading is superior to the auditive.

This may depend on the fact that the sighted are more used to visual reading than auditive, which in turn means that sighted people, perhaps by training, have a better visual perception strategy than their auditive one. If this is correct, blind people ought to have better listening strategies than the sighted have.

If a visually handicapped person has through training acquired a more efficient listening strategy, this should have the following empirical consequences:

A. The strategies should be related to listening training, e.g., increasing age should be accompanied by an increasing difference in learning capacity between sighted and visually handicapped in favour of the blind, at least if we use meaningless material in which there is little possi-

bility of assocations.

In one of our experiments we tested the auditive learning results as a function of training. We tested both blind and sighted children of various ages.

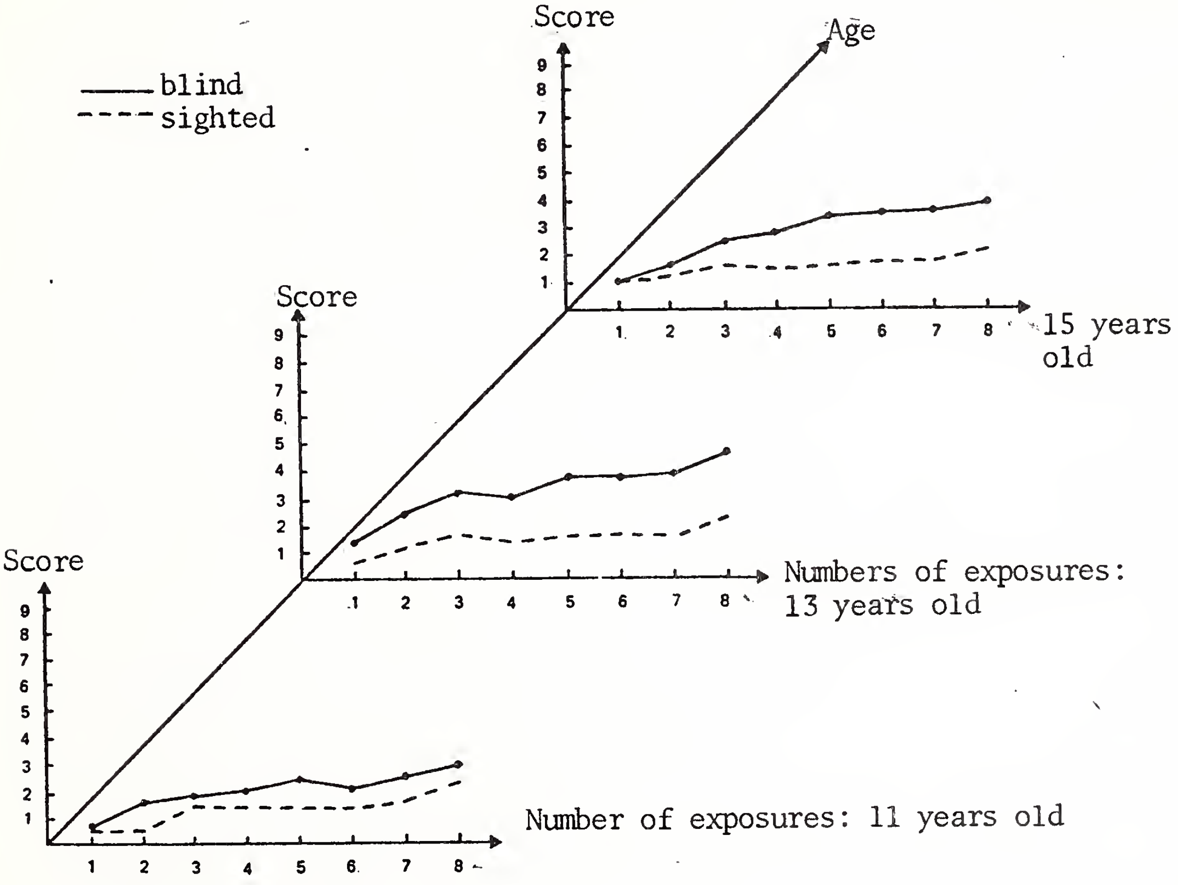

Figure 5. Learning curves for blind and sighted children, respectively, using audial stimul strongly deviating from normal Swedish.

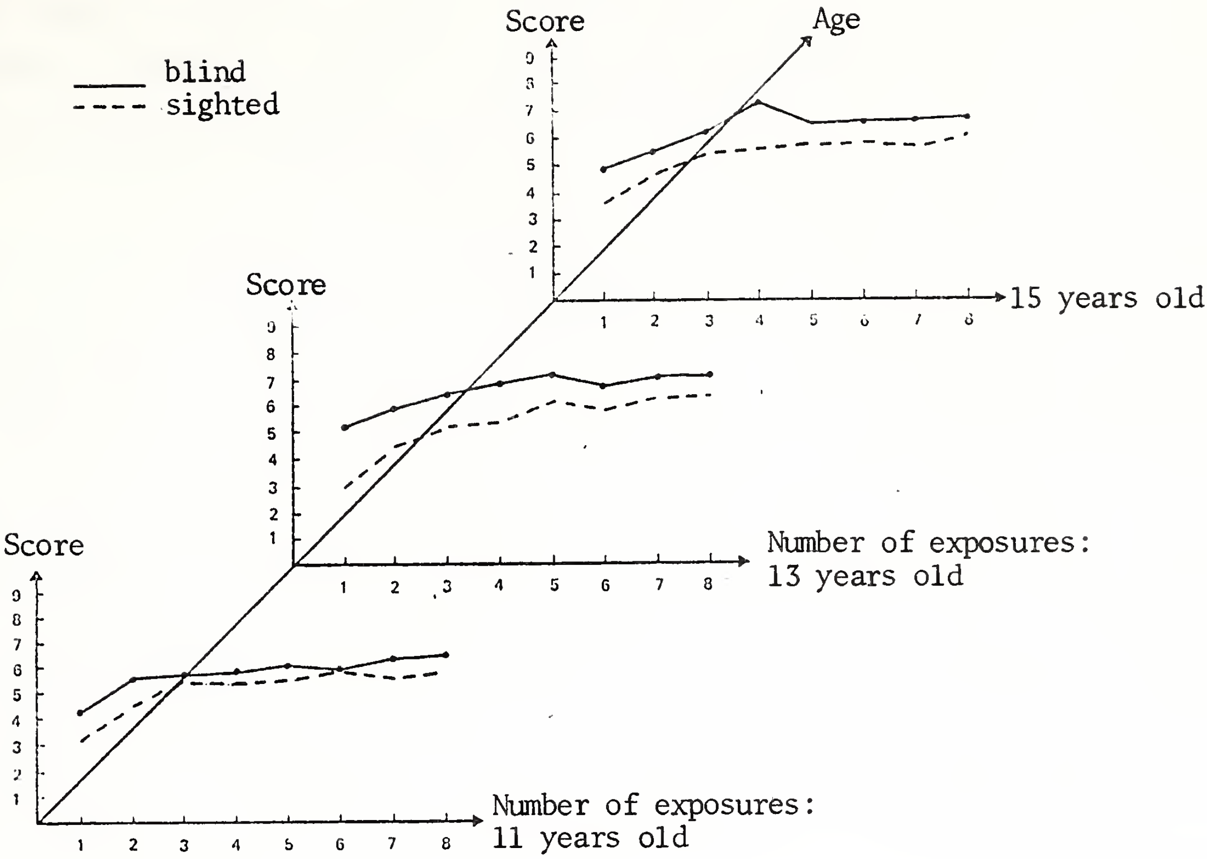

Figure 6. Learning curves for blind and sighted children, respectively, using audial stimuli similar to normal Swedish.

The results show that:

1) blind children are superior to sighted children,
2) the difference between blind and sighted increases as a function of age in favour of the blind,
3) the difference in learning speed increases as a function of age in favour of the blind (the angle of the curve changes).

B. If the strategy argument holds, sighted persons (who, analogously, should have an efficient reading strategy) should not be particularly fatigued by reading - nor should visually handicapped persons be particularly fatigued by listening. On the other hand, sighted persons who are listening should become fatigued.

To test this we used blind and sighted children (15 years old) in an experiment. We used 3 randomly selected groups of children:
1) Blind children who listened to a text,
2) Sighted children who read the same text,
3) Sighted children who listened to the same text.

After this, we tested the children with a multiple-choice test related both to the beginning and to the end of the text.

The results confirm the strategy theory:

- No difference in learning capacity for the beginning and for the end of the text for the blind;
- No difference in learning capacity for the beginning and for the end of the text for sighted readers;
- Better learning capacity for the beginning of the text than for the end of the text for sighted listeners.

C. Another means of testing the strategy theory might be the following: If a visually handicapped person has acquired an efficient method of processing auditive information, this method should be manifest in the form of better retention of the information even in connection with mechanical serial learning in such a way that the so-called "serial position effect" (= inferior learning of the central positions in a series) will not be as obvious as in sighted subjects.

To test this we compared blind and sighted people with reference to serial learning.

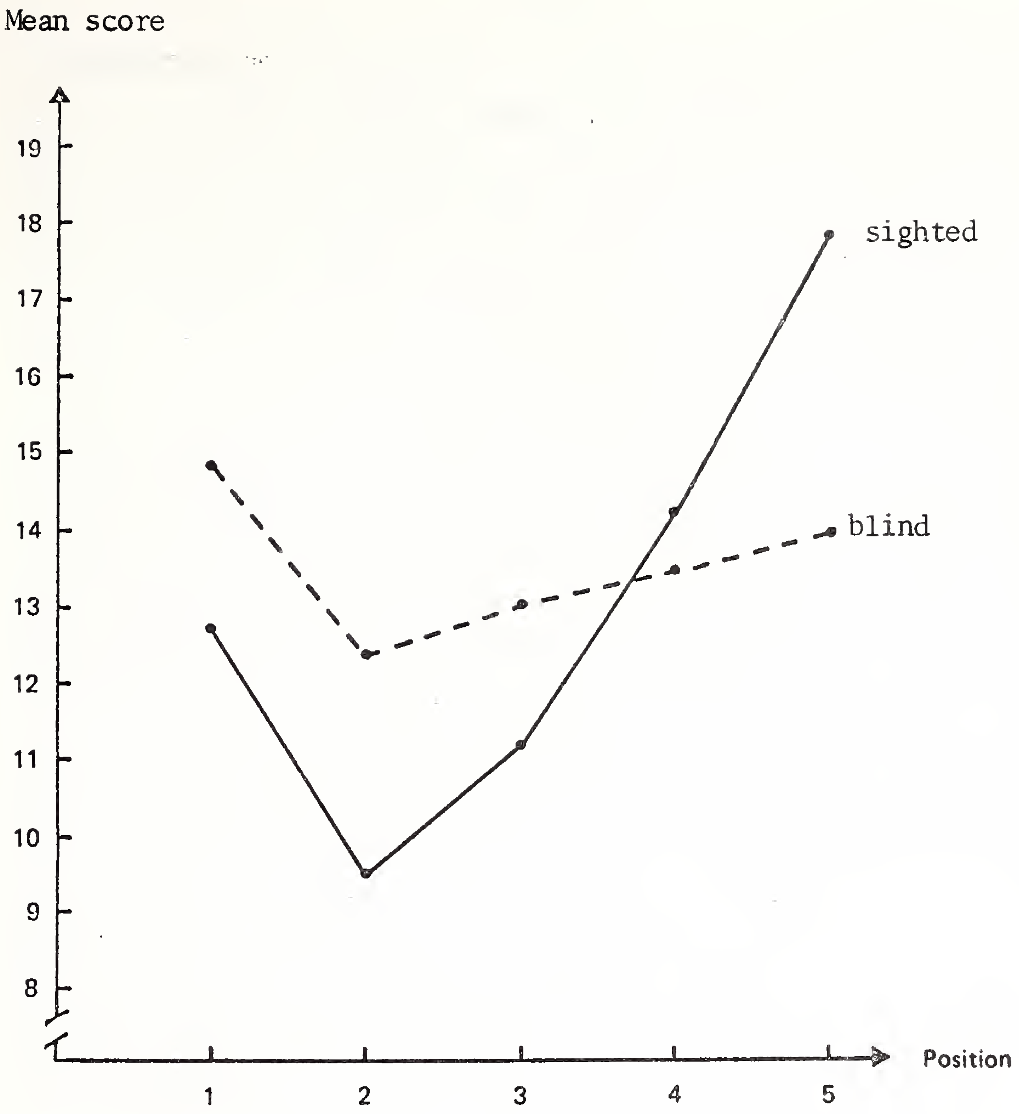

Figure 7. Serial position effects as seen in measurements of short-term memory of audial material. Blind and sighted.

The results confirm the strategy theory. But - as you can see- this is only true for positions 1, 2 and 3 of the five positions, and not for positions 4 and 5. This may depend on the fact that the test came immediately after presentation of word 5. If the more efficient strategy for the blind means that they have learned to organize the material better, an organization that needs some time, then this result for position 4 and 5 once again confirms the theory, as there was no time here for this organization.

D. Another way of testing the learning strategy theory is to study how blind and sighted listeners behave in a listening situation. If both groups are able to listen to a tape recorder where they can vary the speed themselves and if the blind listeners prefer to listen to the talking book at a speed that is more rapid than the sighted, this could indicate that the blind are able to listen more effectively than the sighted.

To study this theory we arranged an experiment in the following way:
A text of gradually increasing difficulty and another with decreasing difficulty were recorded.
21 blind and 25 sighted students were studied when they listened to the text. They used a tape recorder for compressed speech in which they could turn a knob to increase or decrease the speed.

The students were studied individually. We noticed:
a) the speed preferred for the texts and b) when and c) how often they preferred to change the speed.

The experiments show that:
a) Both sighted and visually handicapped pupils prefer to listen to increased speech rates, as all subjects use a more rapid speed than the recorded speed.

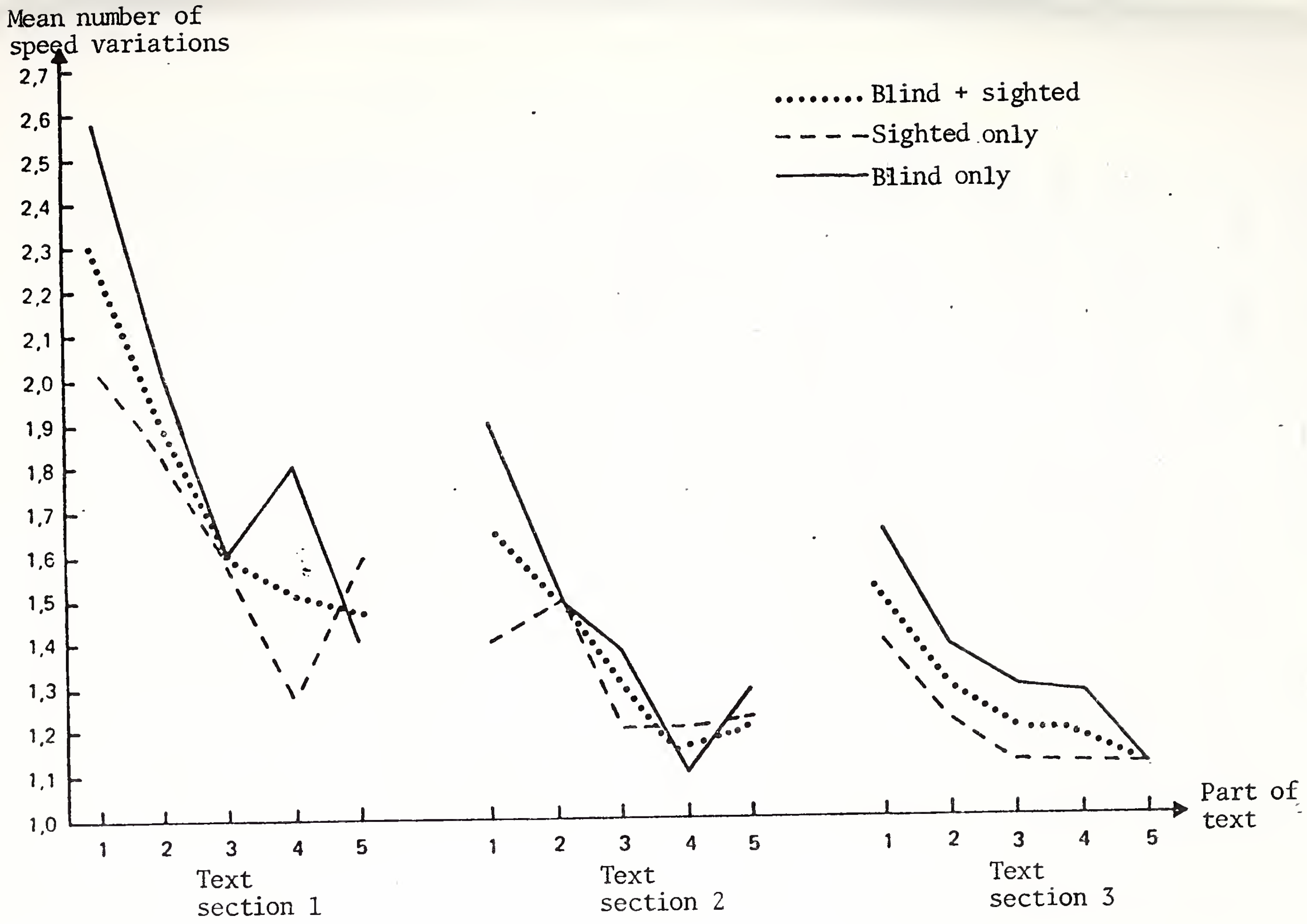

Figure 8. Average number of speed variations as related to parts of the three text sections.

b) A study of individual variations reveals that sighted pupils tend to accelerate the speech by about 20 per cent, while visually handicapped pupils prefer increases of up to 50 per cent, something that once again supports the strategy theory.

c) Speed variation is correlated with the level of difficulty of the text, so that higher speeds are preferred for easier texts and vice versa.

d) The number of speed variations increases if the level of difficulty of the text is changed, which means that efforts are clearly made by the individual to find a speed suitable for each text, just as with sighted people who read their book at the speed they want - and not at a speed prepared in advance.

When the blind are able to listen to texts with a speed that they choose themselves, the variation in obtained knowledge between different listeners decreases.

A consequence of this is that there is no point in preparing talking books with increased speed in advance, as one of the most important reasons for compressed speech is that it makes it possible to read at different speeds for different people and for different texts.

Table 1. Average speed for individual variations of speed for blind and sighted, respectively, for various texts (1=normal speed, 2= doubled speed)

| Text section | Blind | | | n | Sighted | | | n |
|---|---|---|---|---|---|---|---|---|
| | Easy | Mean | Difficult | 10 | Easy | Mean | Difficult | 12 |
| Average speed | 1.46 | 1.45 | 1.31 | | 1.19 | 1.16 | 1.06 | |
| Variance | 0.03 | 0.03 | 0.04 | | 0.02 | 0.04 | 0.02 | |
| Text section | Easy | Mean | Difficult | 11 | Easy | Mean | Difficult | 13 |
| Average speed | 1.24 | 1.38 | 1.47 | | 1.11 | 1.19 | 1.29 | |
| Variance | 0.03 | 0.09 | 0.10 | | 0.02 | 0.01 | 0.03 | |
| Total | | | | 21 | | | | 25 |

In summary it can be said that we have found evidence for the fact that the visually handicapped possess a superior ability to learn auditive material, and that this ability is most probably due to increased training in organizing material and in resisting inhibitions. A consequence of this may be that systematic training in listening should be given to the visually handicapped to a greater extent than is the case at present and that tape recorders with a variable rate ought to be given to blind listeners, as such a listening situation seems to be more effective.

## 6. Practical applications

In our studies we have found that people who are in active learning situations (writing a compendium, taking notes, etc.) find it easier to learn the material in question. Thus, if we summarize the practical application of the pedagogical and physiological research, a person listeing to a tape-recorder should be able to learn a material considerably more effectively if he or she is activated in various ways. There are several different ways in which the visually handicapped pupil can arrange his listening situation so that his learning will be more effective: by necessitating mental activity on the part of the listener, e.g., by construction of questions and by recitation.

This can (as a suggestion) be done in the following way, a method that we have taught all blind students in our so-called "preparatory courses" in study techniques since 1967. A follow-up study 1973 showed that many students use the method and like it.

Two tape recorders are required. One is the talking book, the other a "four-track recorder" with a microphone.

As soon as the talking book says something important,(e.g., if you read a book in psychology, one of the first important pieces of information may be a definition of psychology), you stop that tape recorder for a few seconds and with the help of the other tape recorder, you record on track one the question: "What is the definition of psychology?"

Then you shift to track two, into which you record the answer. After this you go on listening to the talking book until you find something else of importance.

This method keeps you mentally active during the reading of the book - if you are not active, you cannot construct the questions.

Furthermore, the method keeps you active even when you repeat the compendium: you listen to a question and if you know the answer, you repeat it to yourself - if not, you change to the other track to obtain the answer, and so on.

This kind of recitation is very good for learning. It is important, however, to let the students construct the questions themselves. If we give the students questions on the text in advance they will merely learn the parts of the text pertinent to the questions. There is little or no transfer to other part of the text. (This is important for teachers who describe the "goals" to students).

This kind of listening is closely related to experiments which show that recitation is important. Many years ago Gates (1971) showed that the more time you use for recitation instead of reading, the more you will learn.

Table 2.

| Time used for | | retention, number of words |
|---|---|---|
| reading | recitation | |
| 100 | 0 | 65.4 |
| 80 | 20 | 92.2 |
| 60 | 40 | 99.7 |
| 40 | 60 | 105.5 |
| 20 | 80 | 137.3 |

Another way for recitation could be the use of pauses in the talking book. Many research people have shown its beneficial effect. During such pauses the student will be able to recite.

Another practical application of this paper concerns those motor activities I mentioned earlier. By making some kind of motor activity necessary, you increase the activity of the brain.

If the students are working with this "Two-track-method", they are forced to use motor activity. The same happens to the student who is listening to compressed speech, if the tape is not prepared in advance. If the student is forced to turn a knob for the speed he wants, two important things happen:

a) he will have a relevant motor activity

b) he can listen to the text at a speed that suits him for this particular text.

If the student arranges a combination of those two things and the use of the "two track method", I think he has arranged a good listening situation. Finally: if we add training in listening ability(just as we now arrange training in Braille) we shall help our blind children to develope a more effective listening ability.

How this listening training will be arranged is difficult to say, but this spring (1975) we hope to obtain more information about what those learning strategies consist of, and then I think that we subsequently, may have better information as to how training programs will be arranged.

It is also important that we observe theoretical and practical knowledge when we record the talking books. In our project we have tried to systematize what we and other people know about this. During spring, 1975, we shall print a report about this. All who are interested in that report and in our research are invited to give me their name and address, so that I may put them on our mailing list.

Co-operation between research people in different countries and between teachers and research people, etc., is very important. Otherwise, much of our job may perhaps be done in vain.

## III. RESEARCH ON BRAILLE READING

by Margareta Löthman. Research Assistant in the PUSS-Project at the Department of Educational Research, School of Education, Uppsala

### 1. The "PUSS-device" for the analysis of Braille reading

I will try, very briefly, to give you an idea about what is happening in Braille research in Sweden. There are mainly two things that I would like to discuss: The first is a special device for analysing the Braille reading process and the second is an investigation concerning reading rates when contracted and uncontracted Braille is being used.

The investigations concerning Braille reading have been carried out within the framework of the PUSS-project "Educational Research concerning the Study Situation of the Visually Handicapped", conducted by the Uppsala School of Education, in co-operation with the Swedish Association of the Blind, Stockholm. Since there had been no previous Swedish research reported within the Braille reading area, our first task was to study the foreign literature and research reports concerning Braille - mainly English and American - in order to have a Swedish review of investigations and experiments concering Braille as a medium for reading and learning. This is reported in Report No. 42, 1973: Löthman, M.; Braille Reading - "A review of research and description of a device for analysing the Braille reading process." This report also includes a general, as well as a technical, description of the special instrument produced on behalf of the project to make possible a more thorough analysis of the reading process under conditions that are as realistic as possible.

Various kinds of reading machines have been used in earlier investigations, but none of these methods can be considered to present a normal reading situation. Probably as a result of this, there are different conceptions of the reading process and there is no unanimous description of the development of reading behaviour from the beginner to the experienced Braille reader.

Our instrument makes it possible to measure the time interval and with what relative pressure the fingertip touches every single character on a page of Braille. The apparatus can be compared with the eye-movement camera, which gives exact information on the movements of the eye during reading as our instrument gives you exact information of the movement of the reading finger when reading a page of Braille. There is a report translated into English which describes the instrument: "An instrument for

investigation of Braille reading behaviour," by Svärdström, A., Sundström, K-E., Electronics Department, Institute of Technology, Uppsala University.

I'm not very technical so I'm afraid I can't give you a very good description of how this instrument works - but I will, nevertheless, try to give you a picture of the instrument by telling you something about it.

The sheet with Braille is sprayed with a particular silver coating which has a high electric conductivity. I'll pass two examples around so you can see what it looks like. The spraying is made through a mask with 28 vertical slits, each one corresponding to a Braille character column. The mask is made of a sheet of brass using the common photo-resist and etching technique. The subject wears a metal bracelet connected to a voltage source of 12 volts DC. When a finger used for reading touches any of the conductive layers, a weak current of approximately 100 flows from the source through the finger, the conductive layer, and through a resistor to ground. The magnitude of the current is partly determined by the contact resistance between the fingertip and the conductive layer and partly of the subject's skin conductivity. The contact resistance depends on the contact area between the fingertip and the layer and consequently on the pressure applied to the substrata.

To ensure that only his or her fingertip is in contact with the conductive layer, the subject wears a thin plastic glove with a hole for the tip of the reading finger.

Each of the 28 columns is connected to a separate resistor giving a voltage proportional to the pressure applied to the different Braille character when a line is read.

We have collected quite a lot of data with the help of this device, but, unfortunately, we have no results ready yet as we are still working with the data-collection. I do, though, have an example here of what the very preliminary data sheets look like, if anyone is interested in the kind of information we get.

However, we hope to be able to present some of the results later this spring. I would like to point out that this device could be used as a diagnostic instrument, for example to find out what individual difficulties there are among pupils in different grades, in order to be able to give them adequate training.

## 2. An investigation concerning contracted and uncontracted Braille

In order to investigate the role of contractions in the reading rate of congenitally blind and adult blind we made a reading study in Sweden and Denmark in 1973. The study was a comparison between uncontracted and contracted Braille and its effect upon the subject's reading rate. The aim of the investigation was also to compare the Swedish contraction system with the Danish system. As there had been a change of contraction system in Denmark in 1971 we were, in addition, interested in the Danish Braille readers reaction to this change. This was of special interest for us since for some years we in Sweden have been working on a new or revised contraction system.

In Sweden we don't teach Braille grade 2 from the beginning but start with fully spelt Braille for both children and adults. Not until later - for the children generally in grade 4 - do we introduce the various contractions.

It is generally accepted that the contractions used in different countries diminish the space from 10 to 30 per cent, but we have not been able to find any information about the time-saving effect, and therefore were interested in seeing if we could find out something about this.

The subjects consisted of 40 adult Braille readers from Sweden and from Denmark; 20 from Sweden and 20 from Denmark. The subjects were divided into two groups. Group 1 consisted of 9 male and 12 female congenitally blind and their ages varied from 21 to 61 years of age. Group 2 consisted of 10 male and 9 female adult blind in the age group of 18 to 52 years. All of the adult blind subjects had been practising Braille for at least 3 years.

The material used for the reading test was selected from three novels by different foreign authors translated into Swedish and Danish, each one representing different levels of difficulty. Text no. 1 was considered an easy text, the second was of medium difficulty and the third was rather difficult. The authors of the text were Hemingway, Alistair MacLean and Heinrich Böll. A readability index was calculated for each of the texts and the subjects also estimated the level of difficulty for each text. And all of the subjects rated text no. 2 as the most difficult one, which is also shown very clearly in the resulting figures. The subjects read the texts aloud. Each text was divided in two parts - one translated into

uncontracted Braille and one part into contracted Braille.

I will show you some of the results. The figures represent the mean-reading rate in w.p.m. (words per minute) for the two groups.

Table 1

| | Group 1 - congenitally blind<br>Sweden | <br>Denmark |
|---|---|---|
| Text 1 | | |
| contracted | 84 | 79 |
| uncontracted | 91 | 97 |
| increase in % | 8,3 | 22,8 |
| Text 2 | | |
| contracted | 74 | 73 |
| uncontracted | 81 | 81 |
| increase in % | 8,3 | 10,9 |
| Text 3 | | |
| contracted | 90 | 85 |
| uncontracted | 98 | 93 |
| increase in % | 8,8 | 9,4 |

Table 2

| | Group 2 - adult blind<br>Sweden | <br>Denmark |
|---|---|---|
| Text 1 | | |
| contracted | 27 | 32 |
| uncontracted | 27 | 39 |
| increase in % | - | 21,9 |
| Text 2 | | |
| contracted | - | 28 |
| uncontracted | - | 32 |
| increase in % | - | 14,4 |

As shown in the tables the Danish system seems to be slightly more efficient than the Swedish.

It is evident that contracted Braille has a time-saving effect as well as being space-saving. This seems to be true both with congenitally blind readers and with Danish adult blind, but not with adult blind readers in Sweden. As a matter of fact, the adult blind readers in Sweden found it

so difficult and tiring to read Braille that they were only capable of reading the first text.

That is the reason why we didn't get any figures for text 2. Neither in Sweden nor in Denmark did the adult blind subjects read the third text, as reading the two first texts took quite a long time for these subjects; a fact which is also shown in their very low reading rates.

The following results were obtained concerning the reading behaviour of the subjects.

Group 1

16 subjects read with both of their index fingers.
2 subjects read with their right index finger only.
1 subject read with his left index finger only.

Result: 76 % of the congenitally blind used both their index fingers when reading.

Group 2

13 subjects read with their left index finger only.
4 subjects read with their right index finger only.
2 subjects read with both index fingers.

Result: 68 % of the adult blind used their left index finger when reading. In this instance, therefore, there is an obvious difference in the reading behaviour of congenitally blind and adult blind. On our questionnaires was a question as to why the adult blind subjects chose the left hand for reading - they couldn't though, give any special reason for this.

As mentioned before, we also asked the Danish subjects about their attitudes to the change of their revised contraction system.

Among the adult blind there were:

a) 6 subjects who didn't find it difficult or in any way irritating, but only thought this was much better and more effective.
b) 2 who had found it a bit difficult in the beginning - but now found it better and more effective.
c) 2 who had found it difficult.

Among the congenitally blind one subject had found it a bit irritating in the beginning but the rest of the subjects had had only good experiences.

This is, of course, as you will understand, a very short and limited summary, and I haven't gone into any details at all. But, as I mentioned

in the beginning, my aim is only to give you an idea of what is going on in the Braille reading field in Sweden.

At present we are mainly working with the data obtained from the investigations with our special instrument.

## IV. RESEARCH ON READING PROBLEMS OF THE PARTIALLY SIGHTED

by Hans Smedshammar, research assistent in the PUSS-project at Department of Educational Research, School of Education, Uppsala

Four separate investigations of the reading problems faced by the partially sighted are currently taking place under the auspices of the PUSS-project "Educational Research conserning the Study Situation of the Visually Handicapped", conducted by the Uppsala School of Education, in cooperation with the Swedish Assosiation of the Blind, Stockholm. The first investigation is concerned with measuring and registering movements of the eye during reading. The second involves the development of a reading test which may be used in connection with reading training. The third is concerned with the evaluation of various reading aids, while the fourth and last involves the study of the most appropriate typography for books read by the partially sighted.

### 1. Registering the movements of the eye during reading.

For individuals with normal sight, the movements of the eye have been accurately determined by various investigations. On the other hand, there exist no equivalent studies for the reading behaviour of the partially sighted. It may be presumed that this to a great extent depends upon certain methodological difficulties concerning the actual registration of such behaviour. Movements of the eye are normally studied through films of the cornea and its movements. This technique, however, may not be applied in studies of the partially sighted, since they as a rule use optical aids which do not allow the use of film. Another method which has also been used involves the registration of electropotential changes which occur in eye muscles during eye movements. Although this type of measurement technique has previously been shown to be relatively inexact, it has the advantage of being applicable regardless of the types of optical aids used. With the aid of technical expertise, the PUSS-project has nevertheless been able to further develop this latter method, so that we henceforth can with considerable precision register the eye movements of partially sighted. Another problem facing this type of investigation concerning the partially sighted is the short reading distance such persons possess. It normally lies at about 5 centimeters, so that the paper must be moved back and forth during reading. If study of the reading behaviour of partially sighted is to be meaningful, these movements must also be registered; the PUSS-project researchers have succeeded in constructing a special apparatus which with great accuracy measures such movements of the paper.

Nine partially sighted persons were studied by means of this method; the resultant data is currently under processing and analysis. The purpose of these studies is to produce a detailed description of reading behaviour in the partially sighted, this being among the prerequisites for achieving better reading techniques for such persons.

## 2. Development of a diagnostic reading test.

In the reading training which is administered in order to enable partially sighted to effectively use optical aids, use has hitherto been made of various types of tests, such as letter charts, Jaeger scales, speed tests, etc. They have nevertheless failed to yield the information necessary to the construction of optimal training programmes. The PUSS-project has therefore developed a diagnostic reading test designed to obtain such information. The test is based upon an integration of demands from teachers in the field and basic theories about the reading process. A preliminary evaluation has shown that even in its present state, this test is in practice applicable to reading training work with partially sighted, both in terms of diagnosis, prognosis and classification of the reading ability of students.

## 3. Evaluation of various reading aids.

Evaluation of various reading aids is continuous within the PUSS-project. In one of our investigations we studied whether the microfiche system is a practicable reading aid for partially sighted.

The technique uses a special camera which photographs the material to be read. The resultant film may then be loaded into a microfiche apparatus which projects an enlarged text onto a screen; this yields in practice an approximately fourfold enlargement. This system has the further advantage that the filmed material demands very little space. A 10x15 card will store between 60 and 80 normal pages. Lexicons and reference works should therefore be more accessible with the aid of this technique.

Two studies were carried out in this connexion. The first consisted of a selection of the 3 microfiche apparatuses (out of the approximately 100 commercially available) which could be considered most appropriate for the partially sighted. The second consisted of an evaluation of the usefullness of these selected apparatuses for the partially sighted. In order to assess this, microfiche was examined together with other commercially available reading aids (in this particular experiment, optical aids and

closed-circuti TV. The tasks for the subjects consisted of reading running text and consulting reference works. The results showed that after 5 hours' training in microfiche, almost all the subjects had improved their reading speed. Of the 9 participants, 6 read running text faster with microfiche than with optical aids; 3 of the 4 "TV-readers" read faster with microfiche than with TV. On the other hand, optical aids were superioer to microfiche for the use of reference works. In other words, the microfiche technique would seem to be useful for certain partially sighted persons and can thereby furnish a good complement to already available aids. Furthermore, marketing analysis showed that the fiche system need not cost more than the TV-system; the fiche technique should therefore be developed and tested in practice on a large scale in connexion with reading training for the partially sighted. It should nevertheless be noted that the possible uses of optical aids and TV differ to some extent from those of fiche, primarily because the former offer direct access to printed text and the possibility of simultaneously making notes.

## 4. Typography for partially sighted.

Together with the Graphic Institute (Stockholm), the PUSS-project conducts research as to which typography is the most suitable for the partially sighted. In these investigations, the primary emphasis is upon the influence the type size has upon reading speed, but the influence of character/sign shape and contrast is also being investigated. As far as the latter are concerned, it becomes a question of whether positive or negative text is best. Our hypothesis is that negative text is better for larger type sizes, while the reverse is true for smaller texts. We believe that the resultant transition level lies somewhere within the interval between 12-point and 18-point type size.

# APPENDIX

## CONFERENCE CHAIRMAN

Mr. John A. Wall, M.A. (Oxon.)
Chairman, Southern Regional Association for the Blind.

## SESSION CHAIRMEN

Mr. J.A. Wall, M.A. (Oxon.)
Chairman, Southern Regional Association for the Blind.
Mr. R. Dufton, C.Eng., M.I.Mech.E.,
Director of Research, St. Dunstan's

Dr. M. J. Tobin. B.A., Ph.D.,
University of Birmingham.

Mr. E. Boulter,
Director-General,
Royal National Institute for the Blind.

LIST OF SPEAKERS

Mr. J. Lorimer,
Lickey Grange School for Blind Children, Bromsgrove, Birmingham.

Dr. M.J.C. Mommers,
Instituut voor Onderuijskunde, Katholieke Universiteit,
Evasmuslaan 40, Nijmegen, Netherlands.

Dr. Ing. H.J. Kuppers,
Forschungszentrum Fur Rehabilitation Prevention Und Berufliche
Bildung, Stiftung Rehabilitation Heidelberg, Germany.

Dr. S.M.Genensky, Ph.D.,
Physical Sciences Dept., Rand Corporation, Santa Monica,
California 90 406, U.S.A.

Dr. R.G. Lansdown, Ph.D.,
Principal Psychologist, The Hospital for Sick Children,
Great Ormond Street, London WC1N3JH.

Miss Alison Shaw,
The National Corporation for the Care of Old People,
Nuffield Lodge, Regents Park, London NW1 4RS.

Dr. K.C.Sykes,
Flinders University, South Australia.

Miss Margareta Löthman,
Pedagogiska Institutionen, Lärarhögskolan,
Östra Ågatan 9, 753 22 Uppsala, Sweden.

Mr. Hans Smedshammar,
Pedagogiska Institutionen, Lärarhögskolan,
Östra Ågatan 9, 753 22 Uppsala, Sweden.

Dr. E. Foulke, Ph.D.,
Graduate School Perceptual Alternatives Laboratory,
University of Louisville, Louisville, Kentucky 40208, U.S.A.

Dr. N. Trowald, Ph.D.,
Pedagogiska Institutionen, Lärarhögskolan,
Östra Ågatan 9, 753 22 Uppsala, Sweden.

Dr. T.G. Whiston, B.Sc., M.Sc., M.Sc., Ph.D.,
Department of Psychology, Manchester University.
Manchester M139PL.

1:3

Dr. J.Gill, Ph.D.,
Department of Engineering, University of Warwick,
Coventry, Warwickshire CV4 7AL.

Appendix 2:1

**The Southern Regional**
**Association for the Blind**
32 Old Queen Street, London, SW1H 9HP
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# The Louis Braille British
# ONFERENCE
# on research into reading and listening by the visually handicapped

Girton College
Cambridge University

6–9 January 1975

# rogramme

**Conference Chairman**
Mr. John A. Wall, MA (Oxon)
*Chairman,*
Southern Regional Association for the Blind.

**The Louis Braille British Conference**

6th - 9th January, 1975,

Girton College, Cambridge University.

This Conference on Research into Reading and Listening for the Blind and Partially-Sighted is International in character, and is being organised by the Southern Regional Association for the Blind as a follow-up of a Conference held by them in 1972, and known as the Leonard Conference It was held at Girton College, Cambridge University, and brought together in Britain for the first time scientists, ophthalmologists, psychiatrists, sociologists and psychologists engaged in University and other based research into visual handicap. All had the common bond of discovering ways either of preventing further blindness or, through the application of the sciences, of helping blind people to overcome difficulties experienced in day-to-day living.

The Association agreed at that time to consider each subject in isolation as and when further results demanded it. Mobility has already been considered in such a way. Reading, the subject of the present 1975 Conference, is now studied in the light of further research together with the related subject of listening. The various research programmes are being linked at the Conference by Dr. Michael Tobin, the Director of the Research Centre for the Education of the Visually Handicapped at the University of Birmingham.

The Conference has been named the Louis Braille British Conference as it is part of overall plans in Britain to mark the 150th anniversary of the invention of the Braille system which is being observed in various ways throughout the world during 1975.

# The Louis Braille British Conference on Research into Reading

## MONDAY, 6th JANUARY

*Chairman for the day —*
Mr. J. A. Wall, MA (Oxon).

| | |
|---|---|
| 12 noon — 2.00 pm | **Registration** |
| 1.00 pm | Luncheon<br>*(by pre-arrangement)* |
| 2.30 pm | **Opening Remarks and Welcome to Conference**<br>Mr. J. A. Wall, MA (Oxon),<br>*Chairman,*<br>Southern Regional Association for the Blind. |
| 2.45 pm | **"The Measurement of Braille Reading Skills in Blind Children"**<br>Mr. J. Lorimer,<br>Lickey Grange School for Blind Children, Bromsgrove, Birmingham. |
| 4.00 pm | Tea |
| 4.30 — 5.30 pm | **"Some Factors Related to Braille Reading by Blind Children in Elementary Schools"**<br>Drs. M. J. C. Mommers,<br>Katholieke Universiteit, Netherlands. |
| 6.15 pm | Sherry |
| 7.00 pm | Dinner |

*Evening free for discussion.*

## TUESDAY, 7th JANUARY

*Chairman for the day —*
Mr. R. Dufton, CEng, MIMechE,
Director of Research, St. Dunstan's.

| | |
|---|---|
| 9.15 am | **"The Multicamera-Multi-monitor Interactive Closed Circuit Television System for Partially-Sighted"**<br>Dr. S. M. Genensky, PhD,<br>Rand Corporation, USA. |
| 11.00 am | Coffee |
| 11.30 am | **"Visual Perception and Reading for Partially-Sighted"**<br>Dr. R. G. Lansdown, PhD,<br>Principal Psychologist,<br>Hospital for Sick Children, London. |
| 1.00 pm | Luncheon |
| 2.15 pm | **"Typographical Factors for Partially-Sighted"**<br>Miss Alison Shaw, London. |
| 4.00 pm | Tea |
| 4.30 pm | **Workshop** |
| 7.00 pm | Dinner |

*Evening free for discussion.*

## d Listening by the Visually Handicapped

### WEDNESDAY, 8th JANUARY

*Chairman for the day* —
Dr. M. J. Tobin, BA, PhD,
University of Birmingham

| | |
|---|---|
| 9.15 am | **General discussion on Tuesday's Papers**<br>Leader of discussion, Dr. M. Tobin. |
| 11.00 am | Coffee |
| 11.30 am | **"Reading and Listening: Compressed and Accelerated Speech Procedure"**<br>Dr. E. Foulke, PhD,<br>University of Louisville, USA. |
| 1.00 pm | Luncheon |
| 2.15 pm | **"Learning Strategies for Blind Listeners"**<br>Dr. N. Trowald,<br>Uppsala University, Sweden. |
| 4.00 pm | Tea |
| | *Rest of afternoon free for discussion.* |
| 7.00 pm | Dinner |
| | *Evening free for discussion.* |

### THURSDAY, 9th JANUARY

*Chairman for the day* —
Mr. E. Boulter, Director-General,
Royal National Institute for the Blind.

| | |
|---|---|
| 9.15 am | **"The Automatic Transcription of Braille"**<br>Dr. T. G. Whiston, BSc, MSc, MSc, PhD,<br>The University, Manchester. |
| 11.00 am | Coffee |
| 11.30 am | **"Methods of Increasing Accessibility of Reading Materials by the Blind"**<br>Dr. J. M. Gill, PhD,<br>University of Warwick. |
| 1.00 pm | Luncheon |
| 2.15 pm | **Reflections on the Conference and its Implications for the Future**<br>Dr. E. Foulke, PhD. |
| 2.30 pm approx. | **Closing of Conference by Mr. J. A. Wall, MA (Oxon).**<br>*Chairman,*<br>Southern Regional Association for the Blind. |

## Tidigare rapporter från pedagogiska institutionen, Lärarhögskolan i Uppsala

| | |
|---|---|
| Rapport nr 1, 1970. | Kretskortsystem EDS 67. Bo Jacobsson. |
| Rapport nr 2, 1970. | Förslag till Material-Metodsystem för förmedling av språklig färdighet hos döva barn i åk 1. Sven Amcoff & Karl-Georg Ahlström. |
| Rapport nr 3, 1970. | Lärarenkät rörande bruket av teckenspråk inom specialskolan för hörselskadade. Sven Amcoff. |
| Rapport nr 4, 1970. | Projektet:PUSS:I. Individualintegrering av gravt synskadade i grundskolan; synpunkter efter en lärarenkät. B. Lindqvist & N. Trowald. |
| Rapport nr 5, 1970. | Hörselskadade barns skolsituation. En komparativ undersökning. Ann-Britt Lundahl & Ann-Mari Odin. |
| Rapport nr 6, 1970. | Ett pedagogiskt organisatoriskt försök i årskurs 1 av gymnasium och fackskola. Bengt Ekman. |
| Rapport nr 7, 1970. | Visuell perception av talljud och avläsestöd för hörselskadade. Sven Amcoff. |
| Rapport nr 8, 1970. | Lästräning i särskolan. Delrapport I. Maja Witting. |
| Rapport nr 9, 1970. | Ett pedagogiskt organisatoriskt försök i årskurs 1 av gymnasium och fackskola. Del II. Bengt Ekman. |
| Rapport nr 10, 1970. | Projektet:PUSS:II. Presentation av projektets genomförda, påbörjade och planerade undersökningar. K-G Ahlström, B. Lindqvist, N. Trowald. |
| Report No. 11, 1970. | Project:PUSS:III. Learning problems in connection with special information media for the visually handicapped - A selected bibliography. Ann-Mari Östberg & Bengt Lindqvist. |
| Rapport nr 12, 1970. | UNDEXKL, version E. Ett statistiskt programpaket. Bo Jacobsson. |
| Rapport nr 13, 1970. | Projektet:PUSS:IV. Figurbeskrivning i talböcker. Förståelse av figurbeskrivningar som funktion av figurkomplexitet och beskrivningskomplexitet. Mats Myrberg, Bengt Lindqvist & Nils Trowald. |
| Rapport nr 14, 1970. | Att lära sig kombinera information som simultant förmedlas till olika sinnen: Jämförelse mellan tre träningsmetoder. K-G Ahlström, K. Liljeblad & L. Liljeblad. |
| Rapport nr 15, 1971. | Uppfattbarheten av frekvenstransponerade stavelser vid simulerad hörselskada. Sven Amcoff. |
| Rapport nr 16, 1971. | Projektet:PUSS:V. Retentionsjämförelse mellan auditiv och visuell information. B. Lindqvist & N. Trowald. |

Rapport nr 17, 1971. Ett individualiseringsförsök i fysik i fackskolans årskurs 2. Bengt Ekman & Stig Grankvist.

Rapport nr 18, 1971. Ett läromedel i svenska för åk 1-2 i specialskolan för hörselskadade. Sven Amcoff, Gunilla Seger & Maija Raittila.

Rapport nr 19, 1971. Systematisk desensibilisering - Prövning av en beteendeterapeutisk metod. Ulla Holm och Gunnar Holm.

Rapport nr 20, 1971. Dataprogram EDS 67. Bo Jacobsson.

Rapport nr 21, 1971. Lästräning i särskolan. Delrapport II. Maja Witting.

Rapport nr 22, 1971. Projektet:PUSS:VI. Synskadades Studiesvårigheter - en elevenkät. B. Lindqvist & N. Trowald.

Rapport nr 23, 1971. TYLA-HÖTA. Undervisningsmaskin för hörselskadade. Bo Jacobsson.

Rapport nr 24, 1971. Effekter av olika facitsvarsschemata vid programmerad undervisning. Bengt Ekman.

Rapport nr 25, 1972. Undervisningsteknologi för handikappade. Bo Jacobsson.

Rapport nr 26, 1972. En inventering av statistiska datorprogram i Skandinavien. Lars Bäckström & Bo Jacobsson.

Rapport nr 27, 1972. Studieteknisk träning i gymnasieskolan. Bengt Ekman.

Rapport nr 28, 1972. Ett pedagogiskt organisatoriskt försök vid Katrinelunds gymnasieskola i Sundsvall. Del II. M. Claesson, B. Ekman, L-E Prosén.

Rapport nr 29, 1972. Arbetsmotivation och arbetsprestation hos mentalt retarderade. Gunnar Holm och Rikard Palmér.

Rapport nr 30, 1972. Projektet:PUSS:VIII. Symboler för taktila kartor. Gunnar Jansson.

Report No. 31, 1972. Project:PUSS:VIII. European Conference on Educational Research for the Visually Handicapped. B. Lindqvist & N. Trowald.

Rapport nr 32, 1972. Kontingenskoefficienten som sambandsmått. En modellstudie. Bo Jacobsson.

Rapport nr 33, 1972. Direktiv information i läromedel. Dess effekt på uppfattbarheten av abstrakta bilder och möjligheter att överföra visuellt material till media tillgängliga för synskadade. Mats Myrberg.

Rapport nr 34, 1972. Projektet:PUSS:IX. Matematiska symboler i punktskrift. Sammanställd och bearbetad av Stig Becker under medverkan av Gunilla Stenberg, Bengt Lindqvist och Nils Trowald.

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| Rapport nr 35, 1972. | Effekter av varierande läsbarhetsindex på ögonrörelser. En jämförelse mellan normalhörande och hörselskadade gymnasieelever. Harry Svensson. |
| Rapport nr 36, 1972. | Projektet PUSS:X. Synskadade och talbokshastighet. Nils Trowald. |
| Rapport nr 37, 1972. | Projektet PUSS:XI. Visualisering av läroböcker och studielitteratur för synskadade: Utvecklingen av illustrationsmaterial i studielitteratur i talboksbiblioteken. Mats Myrberg. |
| Rapport nr 38, 1973. | Läsintroduktion. En delstudie inom EPÅL-projektet. Bo Janson och Kerstin Sundin. |
| Rapport nr 39, 1973. | Projektet PUSS:XII. Typografi för synsvaga. - Översikt och bibliografi. Bror Zachrisson, Hans Smedshammar. |
| Rapport nr 40, 1973. | PEDO EFTER TRE LÄSÅR. Lärares och elevers inställning till det pedagogiskt-organisatoriska försöket vid Katrinelundsskolan i Sundsvall. Bengt Ekman och Maud Jonsson. |
| Rapport nr 41, 1973. | Projektet PUSS:XIII. Studieteknikkurs för synskadade. En beskrivning av preparandkursernas effekt med särskild hänsyn till talboksmetodik. Nils Trowald. |
| Rapport nr 42, 1973. | Projektet PUSS:XIV. Punktskriftsläsning. Forskningsöversikt samt beskrivning av mätapparatur för analys av läsprocessen. Margareta Löthman. |
| Rapport nr 43, 1973. | Projektet PUSS:XV: LÄSHJÄLPMEDLET OPTACON. En utvärdering av utbildningsmetodik och användbarhet. Hans Marmolin & Lars-Göran Nilsson. |
| Rapport nr 44, 1973. | Projektet PUSS:XVI. Linje- och ytsymboler för taktila kartor. Gunnar Jansson. |
| Rapport nr 45, 1974. | Kodningsstrategier vid inlärning av visuellt verbalt material hos gravt hörselskadade. Sven Amcoff & Birgitta Liljedahl. |
| Rapport nr 46, 1974. | Some aspects of the introduction of reading in foreign language teaching in the primary school. With special reference to existing English teaching material published in Sweden. Bo S. Janson. |
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| Rapport nr 48, 1974. | PUSS:XVII. Inläsning av talböcker. Nils Trowald och Mats Myrberg. |
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Rapport nr 51, 1975. Kodningsstrategier hos hörselskadade vid inlärning av trigram under två olika instruktioner. Birgitta Liljedahl

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Rapport nr 53, 1975. Projektet PUSS XIX: Microfichetekniken som läshjälpmedel för synsvaga. H Marmolin, H Smedshammar, N Trowald

Rapport nr 54, 1975. Presentation av EPÅL-projektet. Bakgrund, problem och uppläggning. Lars Holmstrand

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